AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (currently amended) A bipolar plate for an electrochemical cell, comprising:

a first layer having a first plurality of through-hole channels oriented in a first direction;

a second layer having a second plurality of through-hole channels oriented in a second different direction;

a third layer disposed between and bonded to the first and second layers, the third layer having a first set of through-hole header channels in fluid communication with the first plurality of channels, and a second set of through-hole header channels in fluid communication with the second plurality of channels;

a first inlet port and a first outlet port in fluid communication with the first set of header channels; ~~and~~

a second inlet port and a second outlet port in fluid communication with the second set of header channels;

a first metallic seal disposed between the first layer and the third layer and comprising material from the first layer and the third layer, the first metallic seal configured to define a first bond line that encompasses the first plurality of channels, the first inlet port and the first outlet port;

a second metallic seal disposed between the second layer and the third layer and comprising material for the second layer and the third layer, the second metallic seal configured to define a second bond line that encompasses the second plurality of channels, the second inlet port and the second outlet port;

wherein each of the first, second and third layers ~~are~~ have distinguishable through-hole channels with respect to ~~from~~ each other ~~and capable of being made from a different material~~;

~~wherein the first layer and third layer are metallurgically bonded together to define a first bond line that encompasses the first plurality of channels, the first inlet port and the first outlet port;~~

~~wherein the second layer and third layer are metallurgically bonded together to define a second bond line that encompasses the second plurality of channels, the second inlet port and the second outlet port; and~~

wherein the ~~bonded third layer~~ first metallic seal and the second metallic seal are disposed and configured to prevent[[s]] fluid communication between the first plurality of channels and the second plurality of channels.

2. (original) The bipolar plate of Claim 1, wherein:

the first direction is oriented about 90 degrees to the second direction.

3. (original) The bipolar plate of Claim 1, wherein:

the first inlet port and the first outlet port are diagonally disposed with respect to a fluid flow therebetween; and

the second inlet port and the second outlet port are diagonally disposed with respect to a fluid flow therebetween.

4. (original) The bipolar plate of Claim 1, wherein:

the first layer has a first thickness;

each of the first plurality of channels has a first width;

the first width is equal to or greater than about the first thickness and equal to or less than about three times the first thickness;

the second layer has a second thickness;

each of the second plurality of channels has a second width; and

the second width is equal to or greater than about the second thickness and equal to or less than about three times the second thickness.

5. (original) The bipolar plate of Claim 1, wherein:
the first layer has a first thickness;
each of the first plurality of channels has a first width;
the first width is equal to or greater than about 1.5 times the first thickness;
the second layer has a second thickness;
each of the second plurality of channels has a second width; and
the second width is equal to or greater than about 1.5 times the second thickness.

6. (original) The bipolar plate of Claim 4, wherein:
the first width is greater than the second width.

7. (original) The bipolar plate of Claim 5, wherein:
the first width is greater than the second width.

8. (previously presented) The bipolar plate of Claim 1, wherein:
the first set of header channels comprises a first through-hole channel extending from the first inlet port, and a second through-hole channel extending from the first outlet port; and
the second set of header channels comprises a third through-hole channel extending from the second inlet port, and a fourth through-hole channel extending from the second outlet port.

9. (previously presented) The bipolar plate of Claim 8, wherein:
the first, second, third, and fourth, through-hole channels are isolated from each other.

10. (original) The bipolar plate of Claim 1, wherein:

the third layer is diffusion bonded to the first and second layers.

11. (original) The bipolar plate of Claim 1, wherein:

at least one of the first set of header channels and the second set of header channels of the third layer comprises a plurality of header channels.

12. (original) The bipolar plate of Claim 1, wherein:

the first, second, and third, layers are made from titanium, zirconium, stainless steel, or any combination comprising at least one of the foregoing materials.

13. (currently amended) An electrochemical cell comprising:

a first cell separator plate and a second cell separator plate; and

a plurality of membrane-electrode-assemblies (MEAs) alternatively arranged with a plurality of flow field members between the first cell separator plate and the second cell separator plate;

wherein at least one of the plurality of flow field members comprises a bipolar plate, the bipolar plate comprising:

a first layer having a first plurality of through-hole channels oriented in a first direction;

a second layer having a second plurality of through-hole channels oriented in a second different direction;

a third layer disposed between and bonded to the first and second layers, the third layer having a first set of through-hole header channels in fluid communication with the first plurality of channels, and a second set of through-hole header channels in fluid communication with the second plurality of channels;

a first inlet port and a first outlet port in fluid communication with the first set of header channels; ~~and~~

a second inlet port and a second outlet port in fluid communication with the second set of header channels;

a first metallic seal disposed between the first layer and the third layer and comprising material from the first layer and the third layer, the first metallic seal configured to define a first bond line that encompasses the first plurality of channels, the first inlet port and the first outlet port;

a second metallic seal disposed between the second layer and the third layer and comprising material for the second layer and the third layer, the second metallic seal configured to define a second bond line that encompasses the second plurality of channels, the second inlet port and the second outlet port;

wherein each of the first, second and third layers ~~are~~ have distinguishable through-hole channels with respect to ~~from~~ each other ~~and capable of being made from a different material~~;

~~wherein the first layer and third layer are metallurgically bonded together to define a first bond line that encompasses the first plurality of channels, the first inlet port and the first outlet port;~~

~~wherein the second layer and third layer are metallurgically bonded together to define a second bond line that encompasses the second plurality of channels, the second inlet port and the second outlet port; and~~

wherein the ~~bonded third layer~~ first metallic seal and the second metallic seal are disposed and configured to prevent[[s]] fluid communication between the first plurality of channels and the second plurality of channels.

14. (original) The bipolar plate of the electrochemical cell of Claim 13, wherein:

the first layer has a first thickness;

each of the first plurality of channels has a first width;

the first width is equal to or greater than about the first thickness and equal to or less than about three times the first thickness;

the second layer has a second thickness;

each of the second plurality of channels has a second width; and

the second width is equal to or greater than about the second thickness and equal to or less than about three times the second thickness.

15. (original) The bipolar plate of the electrochemical cell of Claim 14, wherein:

the first width is greater than the second width.

16. (original) The electrochemical cell of Claim 15, wherein:

each MEA comprises an oxygen electrode and a hydrogen electrode; and

the first layer of the bipolar plate is proximate the oxygen electrode.

17. (original) The bipolar plate of the electrochemical cell of Claim 15, wherein:

the third layer is diffusion bonded to the first and second layers.

18. (original) The electrochemical cell of Claim 13, wherein the first plurality of through channels define a first active area, and further comprising:

a fluid flow seal about the first active area; and

a fluid flow seal about each of the inlet and outlet ports at the first layer.

19. (original) The electrochemical cell of Claim 18, wherein the second plurality of through channels define a second active area, and further comprising:

a fluid flow seal about the second active area; and

a fluid flow seal about each of the inlet and outlet ports at the second layer.

20. (currently amended) An electrochemical cell comprising:

a first cell separator plate and a second cell separator plate; and

a plurality of membrane-electrode-assemblies (MEAs) alternatively arranged with a plurality of flow field members between the first cell separator plate and the second cell separator plate;

wherein at least one of the plurality of flow field members comprises a bipolar plate, the bipolar plate comprising:

first, second, and third, layers bonded together to form a laminated arrangement, the first layer having a first set of through-hole channels, the second layer having a second set of through-hole channels, and the third layer having a third and a fourth set of through-hole channels, the third layer being disposed between the first and second layers;

the laminated arrangement having first and second inlet ports, and first and second outlet ports;

the laminated arrangement comprising a first metallic seal disposed between the first layer and the third layer, the first metallic seal comprising material from the first layer and the third layer, the first metallic seal configured to define a first bond line that encompasses the first set of through-hole channels, the first inlet port and the first outlet port;

the laminated arrangement comprising a second metallic seal disposed between the second layer and the third layer, the second metallic seal comprising material for the second layer and the third layer, the second metallic seal configured to define a second bond line that encompasses the second set of through-hole channels, the second inlet port and the second outlet port;

wherein the first inlet port, the first set of through-hole channels, the third set of through-hole channels, and the first outlet port, define a first fluid flow path;

wherein the second inlet port, the second set of through-hole channels, the fourth set of through-hole channels, and the second outlet port, define a second fluid flow path;

wherein each of the first, second and third layers ~~are~~ have distinguishable through-hole channels with respect to ~~from~~ each other ~~and capable of being made from a different material~~;

~~wherein the first layer and third layer are metallurgically bonded together to define a first bond line that encompasses the first set of channels, the first inlet port and the first outlet port;~~

~~wherein the second layer and third layer are metallurgically bonded together to define a second bond line that encompasses the second set of channels, the second inlet port and the second outlet port; and~~

wherein the ~~bonded layers~~ first metallic seal and the second metallic seal of the laminated arrangement are disposed and configured to prevent fluid communication between the first fluid flow path and the second fluid flow path.

21. (original) The bipolar plate of the electrochemical cell of Claim 20, wherein:

the third layer is diffusion bonded to the first and second layers.

22. (original) The bipolar plate of the electrochemical cell of Claim 21, wherein:

the first, second, and third, layers are made from titanium, zirconium, stainless steel, or any combination comprising at least one of the foregoing materials.

23. (previously presented) The bipolar plate of Claim 1, wherein

the first set of header channels comprises a first pair of header channels, each of the first pair extending over an opposing end of the first plurality of channels; and

the second set of header channels comprises a second pair of header channels, each of the second pair extending over an opposing end of the second plurality of channels.

24. (new) The bipolar plate of Claim 1, wherein:

the first metallic seal is absent between the first plurality of through-hole channels;

the second metallic seal is absent between the second plurality of through-hole channels.

25. (new) A bipolar plate for an electrochemical cell, comprising:

a plurality of layers bonded together to form a laminated arrangement, each layer having features formed individually therein, the features being selected from at least one of through-hole channels, through-hole header channels, through-hole inlet ports and through-hole outlet ports, the features configured and disposed to provide fluid flow coordination from layer to layer; and

a plurality of metallic seals, each metallic seal disposed between two adjacent layers, each metallic seal comprising material from each respective adjacent layer, each metallic seal configured to define a bond line that encompasses a plurality of the features, each metallic seal configured and disposed to prevent fluid communication across the respective metallic seal.